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ADIPOSE TISSUE IN CZECH SCHOOL CHILDREN. QUANTITY, DISTRIBUTION, CORRELATION ANALYSIS

ABSTRACT: Detection of body fat provides a high degree of information about body composition and nutritional status in men. We ascertained quantity and distribution of adipose tissue in individuals from our sample and correlated the skinfold thickness from various body spots.

The monitoring sample consisted of 1,925 children aged 6–15 years, measured repeatedly in the period 1997–99. We have applied the measurement of skinfold thickness for assessing the subcutaneous fat. The adipose tissue was measured with the Harpenden caliper at 5 body areas on the right site of the body. Standard statistical analyses were used for the evaluation. Percentile distribution of 5 skinfold thickness values is presented in this report. The statistical relationship of linear regression exists between values of skinfold thickness. Correlation coefficients were calculated to assess the degree of this relationship.

The data analysis of the sample proved the following: unequal distribution of subcutaneous fat tissue values, very intense correlation of one skinfold thickness to the sum of 5 skinfold thickneses and only slightly less intense correlation among skinfolds from various spots of the body. Correlations are intersexually different, correlation coefficients vary in relation to age. It results from the previous points that one skinfold thickness value only informs competently about body composition and nutrition status of children.

KEYWORDS: Czech children – Skinfold thickness – Distribution of thickness values – Correlations among skinfold thickneses

INTRODUCTION

Detection of body fat provides a high degree of information about body composition and nutrition status in men. There are several methods of ascertaining the amount of body fat. We have applied the measurement of skinfold thickness for assessing the subcutaneous fat, which is the aliquot fraction of total body fat. The aim was estimation of the following:

1. Quantity and distribution of adipose subcutaneous tissue in individuals from our sample.
2. Correlation between the skinfold thickness value at one spot of the body and the sum of values from five body spots.
3. Correlation among values of skinfold thickness at different spots.

MATERIAL AND METHODS

The monitoring sample consisted of 1,925 children aged 6–15 years measured repeatedly in the period 1997–99. The number of children in age categories is specified in *Table 1*.

The adipose tissue was measured with the Harpenden caliper at 5 body areas. The skinfolds were localized on the upper limb above the *m. biceps brachii* and above the *m. triceps brachii*, on the lower limb above the *m. quadriceps*

femoris, and at the trunk in *regio subscapularis* and *regio suprailiacalis.* The ratio of body fat could be calculated. Standard statistical analyses were used for the evaluation. Because the skinfold thickness values have an asymmetric distribution, we used the logarithmic transformation to obtain the normal distribution of data for a calculation of correlation coefficients (Pearson).

RESULTS AND DISCUSSION

1. Percentile distribution of the sum of 5 skinfold (thickness) values is presented in this report. Distribution of single skinfold thickness and adipose tissue ratio were published earlier (Bláha *et al*. 2002). The percentile distribution frequencies of skinfold thickness are likewise asymmetric, markedly skew, the median is always lower than average. There is several times higher range of values above the 50th percentile than below it. The amplitude of values is 2–5 times higher between the P 50 and P 97 in boys and 1.5–3 times in girls (*Figures 1a, 1b*). The situation is similar in single skinfolds (Bláha *et al.* 2002).

The values increase in boys only until 12 years of age and decrease thereafter till the end of the monitored period at 15 years of age. The pubertal decrease of values does not appear in boys whose fat tissue values are below the 10th percentile. Broad range of values exists above the P 50 (30–120 mm). The prepubertal increase of values is rapid in this group of boys, the pubertal decline is apparent, but since 13–14 years of age the values increase again rapidly towards the maximum at the end of the followed-up period (*Table 2, Figure 1a*).

The skinfold thickness values are higher in girls (*Table 2, Figure 1b*). There is a nearly continuous increase during the monitored period. The pubertal decline of values is mostly absent, a postpubertal decline was registered only in obese girls (P 90, P 97).

2. Correlations. The statistical relationship of linear regression exists between values of skinfold thickness (*Figure 2*). Correlation coefficients were calculated to assess the degree of this relationship. They oscillate around R=0.9 in relationship between one skinfold thickness to the sum of 5 skinfold thicknesses. The values of correlation coefficients are affected by the fact that the correlated skinfold is included in the sum of 5 skinfolds.

The tightest correlations are between the skinfold thickness on the frontal thigh (above *m. quadriceps*

TABLE 1. Number of children in age categories.

Age category	Boys	Girls
6.00–6.99	219	255
7.00–7.99	468	459
8.00–8.99	653	646
9.00–9.99	561	533
10.00–10.99	557	553
11.00–11.99	517	421
12.00–12.99	580	524
13.00–13.99	499	382
14.00–14.99	345	320
15.00–15.99	153	111

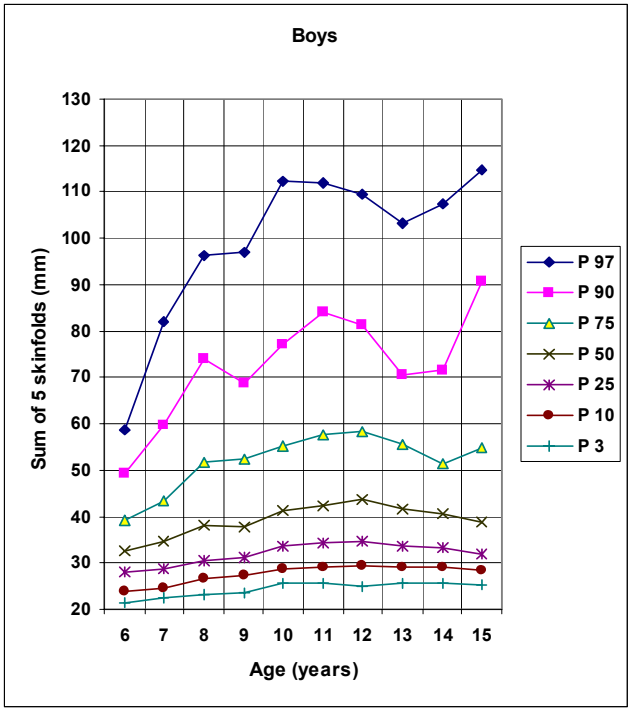

FIGURE 1a. Sum of 5 skinfolds (mm). Percentile distribution of values.

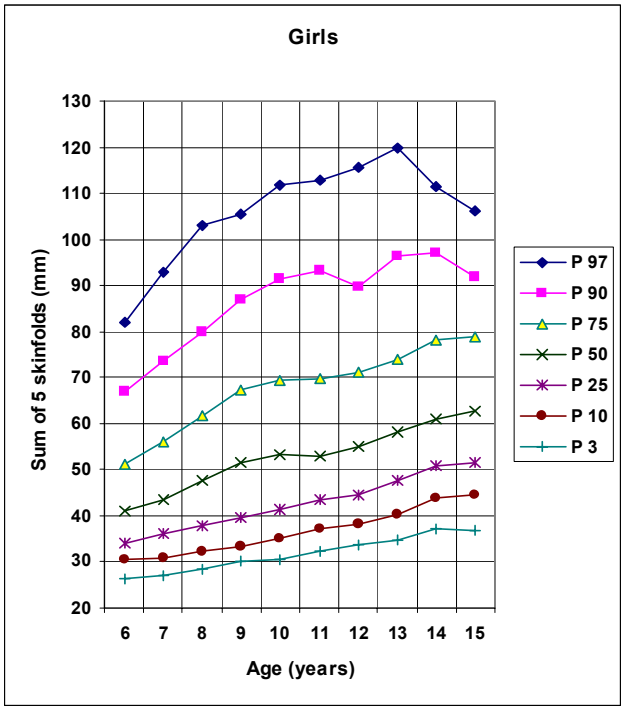

FIGURE 1b. Sum of 5 skinfolds (mm). Percentile distribution of values.

TABLE 2. Sum of 5 skinfolds – percentile distribution of values in mm. Boys, girls aged 6.00–15.99 years.

Age category	6.00–6.99	7.00–7.99	8.00–8.99	9.00–9.99	10.00–10.99	11.00–11.99	12.00–12.99	13.00–13.99	14.00–14.99	15.00–15.99
Percentile										
Boys										
P 97	58.69	81.79	96.09	97.04	112.33	111.85	109.37	103.14	107.34	114.68
P 90	49.34	59.83	73.96	68.90	77.22	84.20	81.42	70.40	71.44	90.52
P 75	39.30	43.20	51.60	52.20	55.20	57.60	58.25	55.50	51.40	54.70
P 50	32.40	34.70	38.10	37.90	41.40	42.20	43.70	41.60	40.40	38.70
P 25	28.15	28.58	30.50	31.20	33.60	34.40	34.75	33.60	33.20	32.00
P 10	23.78	24.57	26.52	27.40	28.80	29.10	29.27	29.00	29.20	28.36
P 3	21.25	22.40	23.16	23.52	25.67	25.44	24.74	25.60	25.50	25.25
Girls										
P 97	82.15	92.81	103.06	105.65	111.63	112.94	115.74	119.96	111.26	106.02
P 90	66.98	73.64	79.75	86.76	91.36	93.30	89.82	96.41	97.02	91.80
P 75	51.25	56.00	61.58	67.20	69.40	69.80	71.23	73.78	78.10	78.95
P 50	41.00	43.50	47.80	51.50	53.30	53.00	55.00	58.10	60.90	62.60
P 25	34.10	36.05	38.00	39.50	41.50	43.40	44.40	47.80	50.98	51.45
P 10	30.68	31.00	32.35	33.40	34.92	37.30	38.20	40.42	43.89	44.40
P 3	26.37	26.87	28.24	30.10	30.56	32.36	33.78	34.89	37.29	36.71

TABLE 3a. Correlation coefficients R in various ages. Boys.

Age category	6.00–6.99	7.00–7.99	8.00–8.99	9.00–9.99	10.00–10.99	11.00–11.99	12.00–12.99	13.00–13.99	14.00–14.99	15.00–15.99	
Mean age	**6.65**	**7.51**	**8.53**	**9.46**	**10.53**	**11.48**	**12.51**	**13.46**	**14.47**	**15.33**	**Average**
biceps – 5 skinfolds	0.90	0.93	0.93	0.94	0.93	0.94	0.93	0.91	0.89	0.92	0.92
triceps – 5 skinfolds	0.93	0.93	0.94	0.93	0.92	0.94	0.93	0.93	0.91	0.91	0.93
subscapulare – 5 skinfolds	0.86	0.90	0.91	0.91	0.92	0.92	0.92	0.90	0.90	0.92	0.91
suprailiacale – 5 skinfolds	0.90	0.91	0.93	0.93	0.95	0.93	0.92	0.92	0.92	0.94	0.92
quadriceps – 5 skinfolds	0.94	0.96	0.95	0.95	0.94	0.94	0.93	0.92	0.90	0.88	0.93
biceps – triceps	0.81	0.85	0.86	0.87	0.83	0.90	0.87	0.87	0.83	0.86	0.85
triceps – subscapulare	0.75	0.78	0.81	0.80	0.78	0.82	0.81	0.78	0.75	0.80	0.79
triceps – suprailiacale	0.78	0.79	0.82	0.80	0.82	0.83	0.79	0.79	0.74	0.80	0.80
triceps – quadriceps	0.83	0.87	0.87	0.86	0.84	0.87	0.84	0.85	0.81	0.78	0.84
subscapulare – suprailiacale	0.85	0.91	0.91	0.89	0.92	0.90	0.89	0.89	0.90	0.92	0.90
quadriceps – suprailiacale	0.78	0.81	0.82	0.81	0.84	0.80	0.79	0.75	0.73	0.73	0.79
quadriceps – subscapulare	0.72	0.78	0.79	0.78	0.80	0.78	0.78	0.71	0.69	0.72	0.75

TABLE 3b. Correlation coefficients R in various ages. Girls.

Age category	6.00–6.99	7.00–7.99	8.00–8.99	9.00–9.99	10.00–10.99	11.00–11.99	12.00–12.99	13.00–13.99	14.00–14.99	15.00–15.99	
Mean age	**6.61**	**7.51**	**8.53**	**9.47**	**10.51**	**11.46**	**12.51**	**13.48**	**14.49**	**15.31**	**Average**
biceps – 5 skinfolds	0.87	0.90	0.89	0.90	0.89	0.87	0.89	0.88	0.83	0.85	0.88
triceps – 5 skinfolds	0.89	0.91	0.92	0.93	0.92	0.91	0.90	0.90	0.83	0.84	0.90
subscapulare – 5 skinfolds	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.87	0.86	0.90
suprailiacale – 5 skinfolds	0.90	0.91	0.92	0.92	0.93	0.92	0.91	0.91	0.87	0.87	0.90
quadriceps – 5 skinfolds	0.92	0.93	0.93	0.92	0.92	0.92	0.91	0.91	0.89	0.92	0.92
biceps – triceps	0.77	0.81	0.81	0.84	0.84	0.81	0.82	0.82	0.74	0.71	0.80
triceps – subscapulare	0.78	0.79	0.78	0.80	0.80	0.77	0.77	0.77	0.65	0.63	0.76
triceps – suprailiacale	0.75	0.77	0.80	0.81	0.83	0.79	0.76	0.73	0.61	0.61	0.75
triceps – quadriceps	0.74	0.80	0.82	0.84	0.81	0.83	0.79	0.77	0.71	0.75	0.79
subscapulare – suprailiacale	0.86	0.87	0.88	0.87	0.89	0.88	0.86	0.85	0.79	0.78	0.85
quadriceps – suprailiacale	0.75	0.77	0.79	0.78	0.79	0.76	0.74	0.73	0.68	0.73	0.75
quadriceps – subscapulare	0.74	0.75	0.76	0.76	0.75	0.76	0.73	0.73	0.67	0.68	0.73

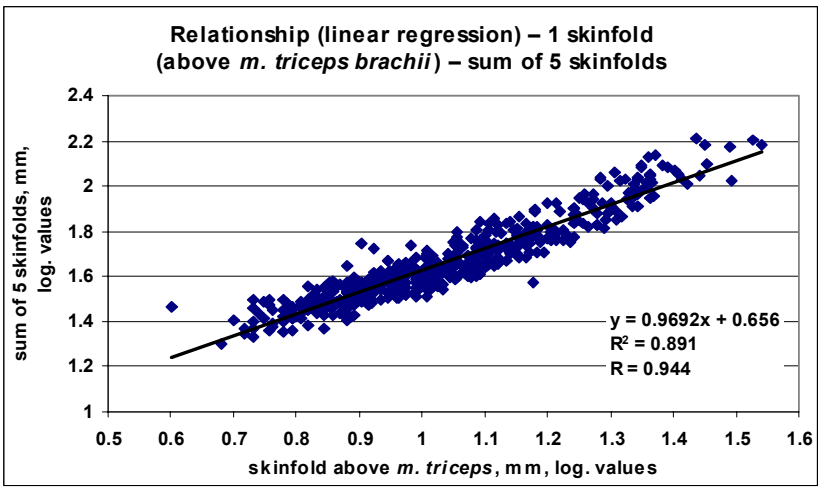

FIGURE 2. Relationship 1 skinfold thickness – sum of 5 skinfold thickneses. Boys aged 11 years.

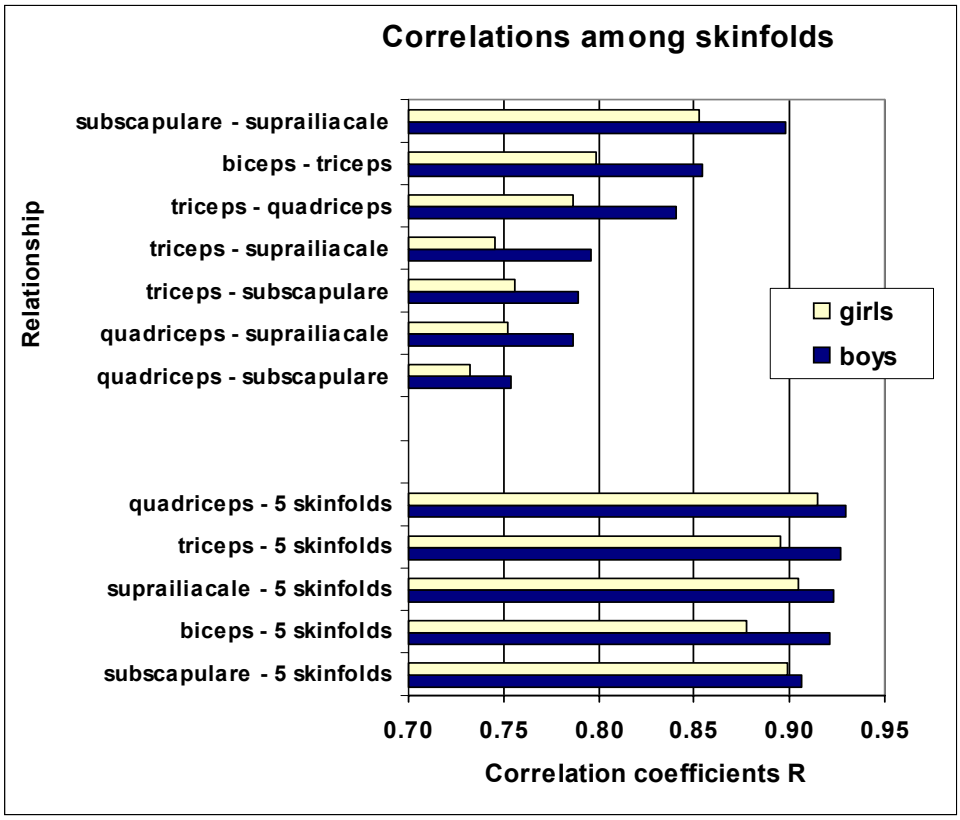

FIGURE 3. Correlations among skinfold thickness, comparison. Boys, girls aged 6–15 years.

femoris) to the sum of 5 skinfold thickneses. Correlation coefficients vary in relationship to the age (*Table 3a, 3b*). Correlations are tighter in prepubertal period in both sexes; correlation coefficients are highest in boys aged 11 and girls aged 9 years, and they are smaller in pubertal children. The correlation coefficients drop to the minimum in boys during the puberty, minimal values in girls are at 14–15 years of age.

Separate skinfolds from different spots of body correlate less intensely (R oscillate around the value of 0.8).

The trunk skinfolds among themselves as well as limb skinfolds among themselves correlate tighter than the trunk-limb skinfolds (*Figure 3*).

We can compare our results (in limited extent) with the results of Bouchalová (1987). Her study interprets the correlation coefficients for relationship among skinfolds in various combinations. Correlation coefficients are little diverged. Statistical comparison is not possible as the methods are not identical. The trends in our results and the cited ones are however equal.

CONCLUSIONS

The data analysis of the sample of 1,925 children aged 6–15 years from several regions of the Czech Republic measured repeteadly proved the following:

1. Unequal distribution of subcutaneous adipose tissue values with multiply higher amplitude of values above the 50th percentile than under P 50, more explicitely in boys than in girls (*Figures 1a, 1b*).
2. Pubertal changes (decrease, stagnation) in the amount of subcutaneous adipose tissue appear only in children whose sum of 5 skinfold values is above the P 25 (girls), resp. P 10 (boys). The trend of permanent increase of the subcutaneous fat was recorded in very slim children aged 6–15 years (*Figures 1a, 1b*).
3. Very intense correlation of one skinfold thickness to the sum of 5 skinfold thickneses (R oscillate around the value of 0.9).
4. Only slightly less intense correlation among skinfolds from different spots of body (R oscillate around the value of 0.8).
5. Correlations are intersexually different, more intense in boys than in girls in all age groups and all calculated combinations.
6. Correlation coefficients vary in relation to age, they are highest in prebubertal and smallest in pubertal age period in boys and in 14–15 year-old girls.
7. It results from the points 3 and 4 that one skinfold thickness value only informs competently about body composition and nutritional status of children. However, the situation can be distinct in overweight and obese persons, and there is a need to perform more detailed examinations in this case.

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